Early Detection Research Network

NASA JPL Jet Propulsion Laboratory California Institute of Technology

Excellence in Computational Biology and Informatics

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FRED HUTCHINSON CANCER RESEARCH CENTER
A LIFE OF SCIENCE

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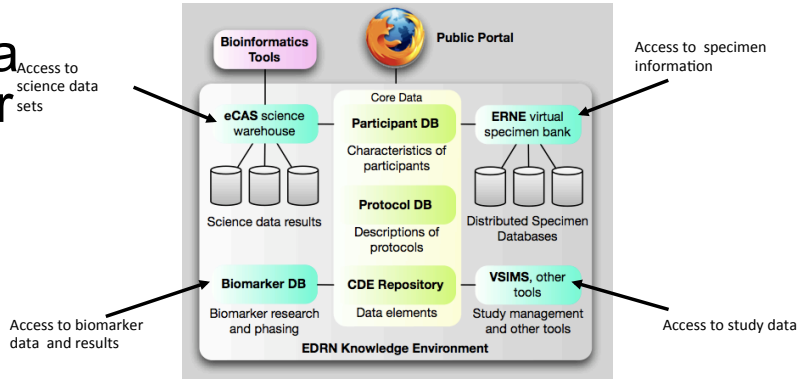
EDRN Informatics

- NCI/JPL partnered since 2001 to develop a long term distributed knowledge system for the EDRN

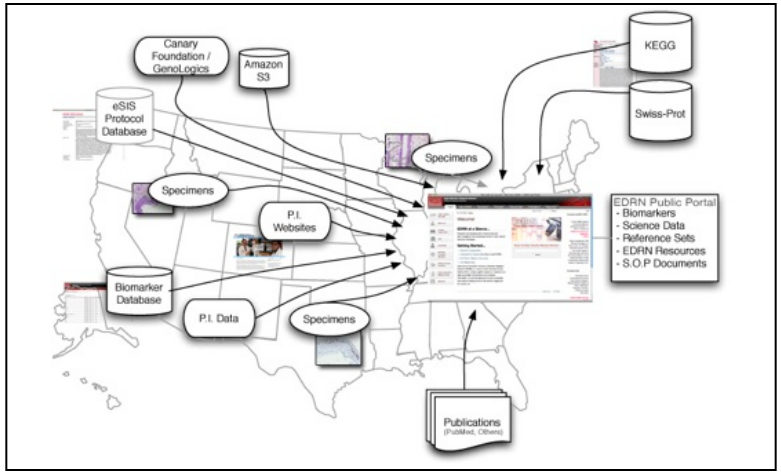
- Significantly leveraged the NASA model
  - Implemented Apache OODT from JPL
  - Architecture and approach
  - Open Source, Data Intensive Science approach
  - 2011 NASA Award for the accomplishment



http://cancer.gov/edrn (operational)
http://edrn.jpl.nasa.gov (beta; emerging capabilities)

Integrated knowledge environment

- Supports capture and access to a diverse collection of distributed sets of information and results
  - Biomarkers
  - Biospecimens
  - Scientific Data Sets
  - Protocols
  - Etc

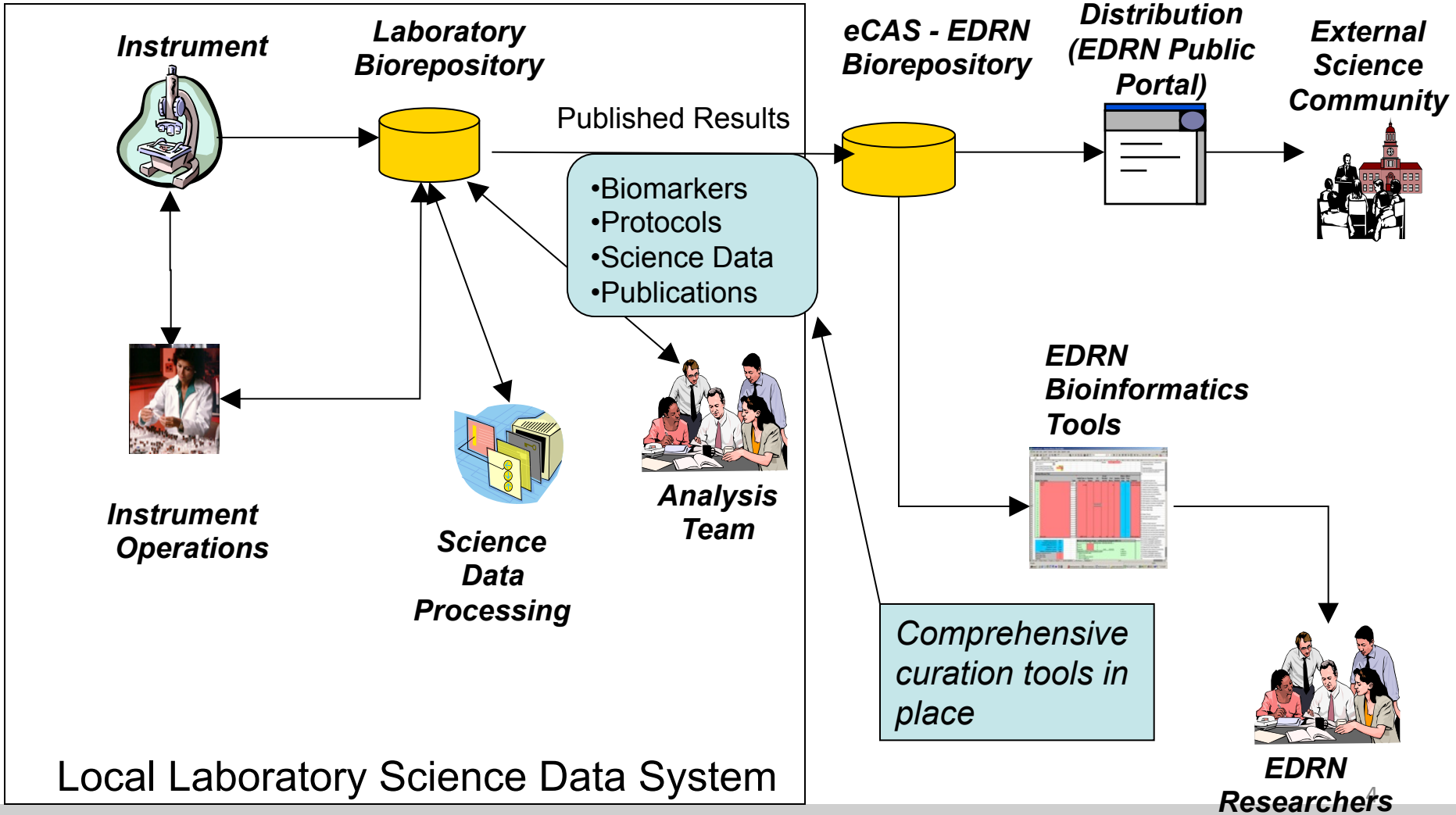


Supporting the Science Data Lifecycle

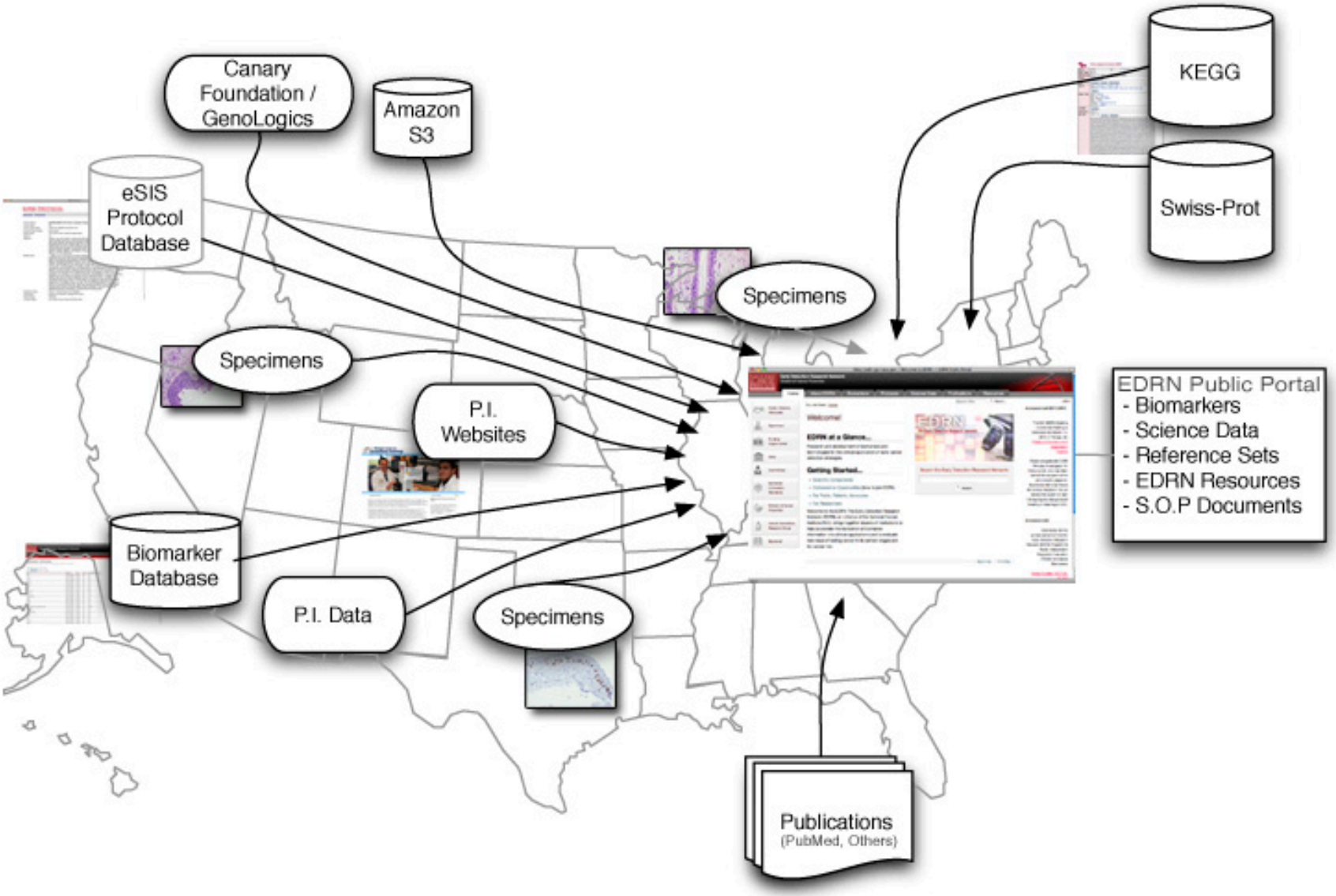
- *Ingestion of data*: Steps for transformation and validation including curation and peer review of the data
- *Cataloging of Structured and Unstructured Data*: Separation of the description (catalog) of data from the physical data storage
- *Data Processing*: Highly validated, scalable pipelines and jobs for remote sensing instruments; versioning of algorithms and data; this can be done by distributed teams prior to submitting to national archives
- *Data Management*: Construction and management of metadata catalogs and data (often distributed); capture of raw and processed data.
- *Data Discovery*: Discovery of data for scientific research
- *Data Access*: Access to the scientific data
- *Data Distribution, Computation and Analysis*: Support for analysis and services (e.g., subsetting) on the data; move towards automated data discovery

Capture of Public Science Data

An Integrated Repository of Public Data Sets



A Virtual, National Integration Biomarkers Knowledge System



Biomarker Knowledge System: An integrated semantic architecture

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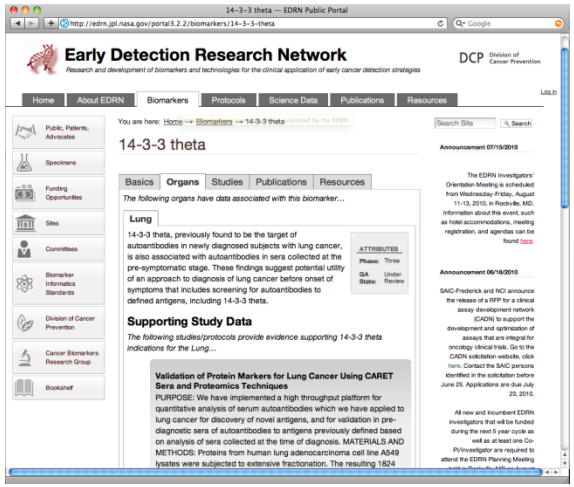
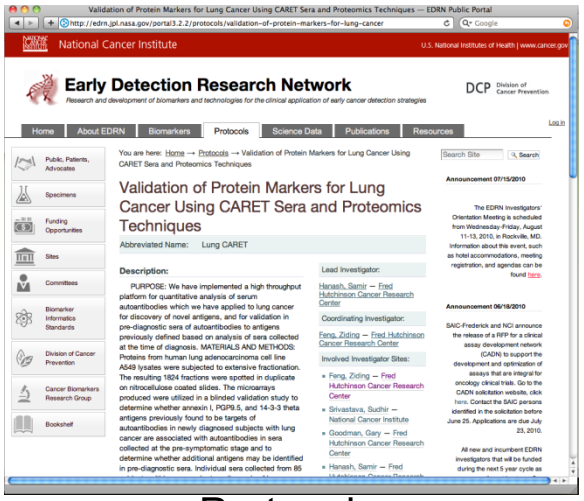
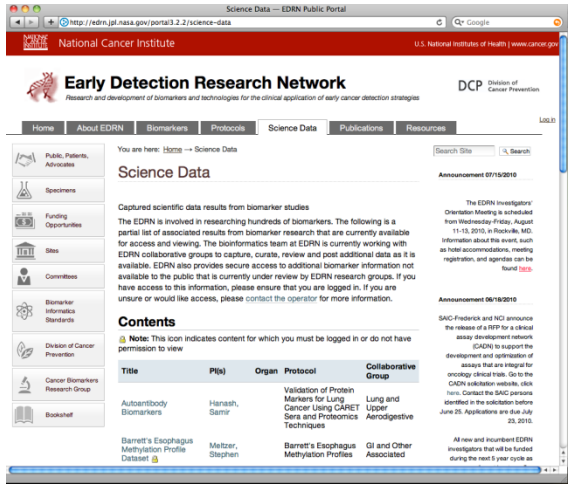


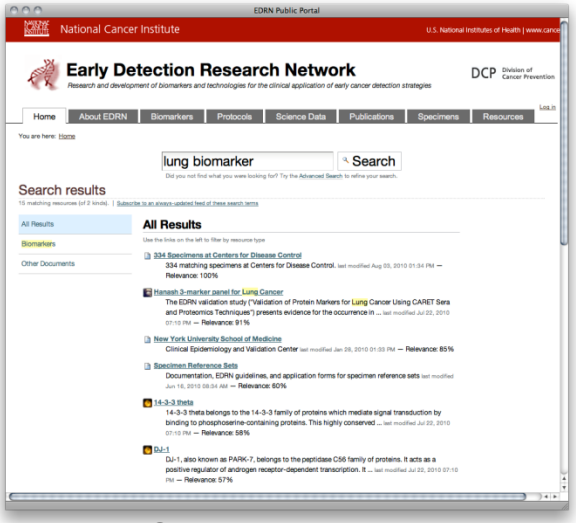
Biomarker Annotations



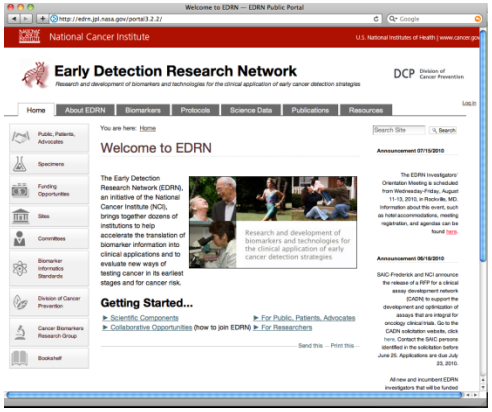
Protocols



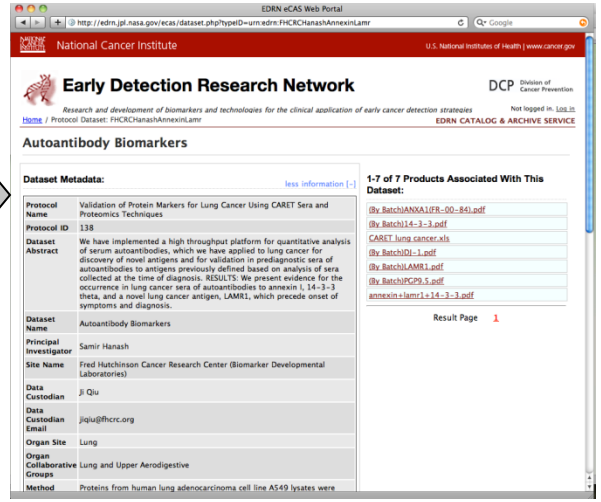
Biomarker Data Results



Specimens



Linked through
Public Portal

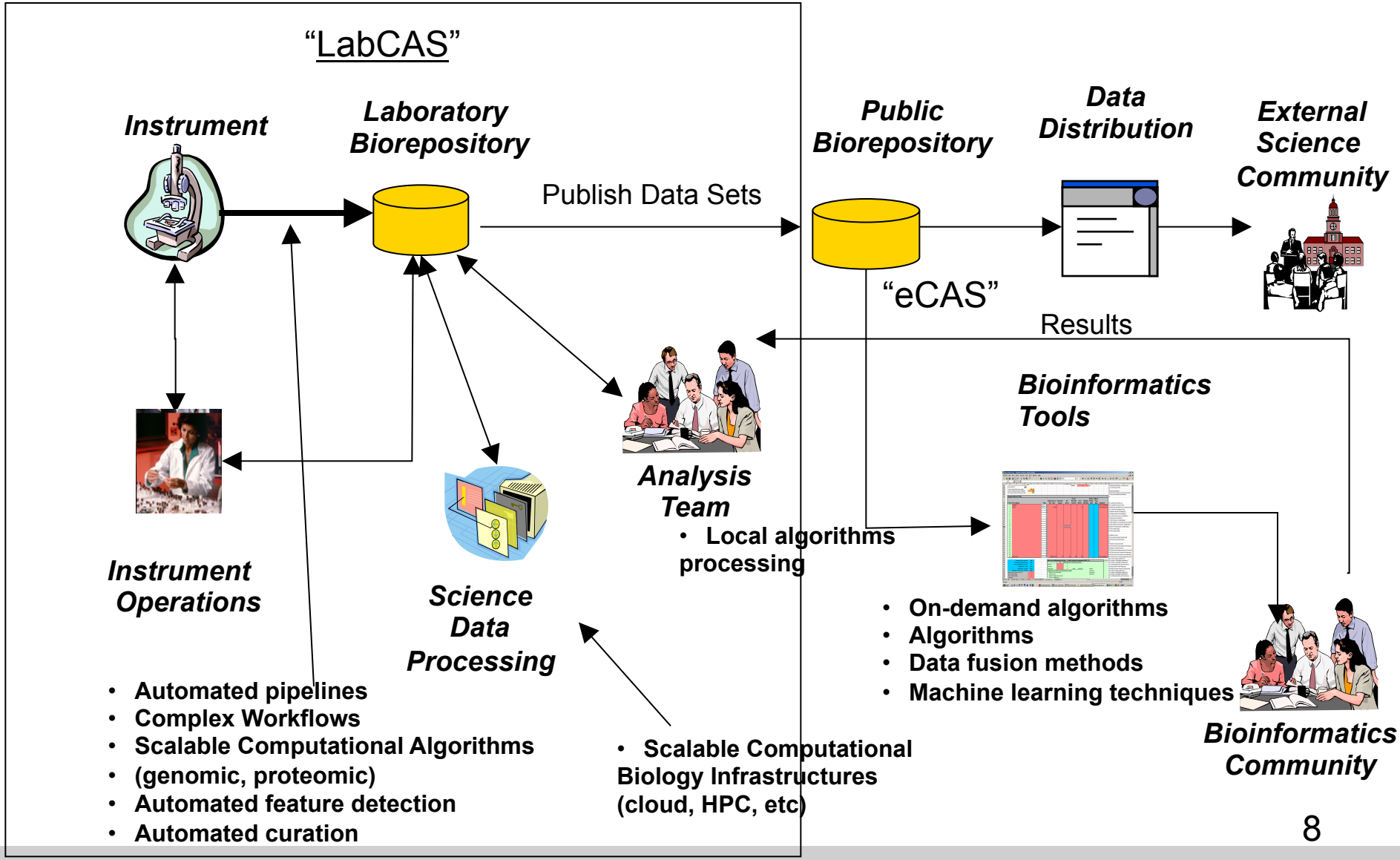


Access to download data

Cancer Biomarker Bioinformatics Workshop

- The EDRN and NASA Jet Propulsion Laboratory held a workshop in May 2013 at Caltech to address informatics and data-driven research in cancer biomarkers
  - http://edrn.nci.nih.gov/cancer-bioinformatics-workshop/cancer-biomarker-bioinformatics-workshop-report-may-2013
  - A major outcome focused on data usability, reproducibility of results, methods and algorithms to systematize data analysis, and scalable computing infrastructures.
- Key Recommendations
  - Systematic approaches to the generation, capture, management of data to enable reproducibility.
  - Increased emphasis on data curation to promote data reuse
  - Automation of data process/analytics software pipelines
  - Data integration and fusion of data from multiple platforms, studies
  - Scalable data infrastructures and repositories
  - Use of big data tools and bioinformatics techniques to scale data analysis
  - Increased training of scientists in the use of computational tools/methods

Moving towards data-driven science for cancer biomarkers



Application of Machine Learning Techniques

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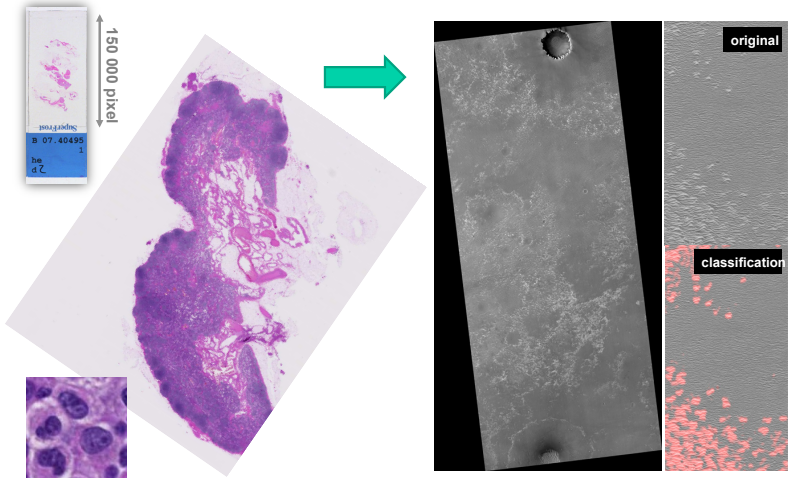
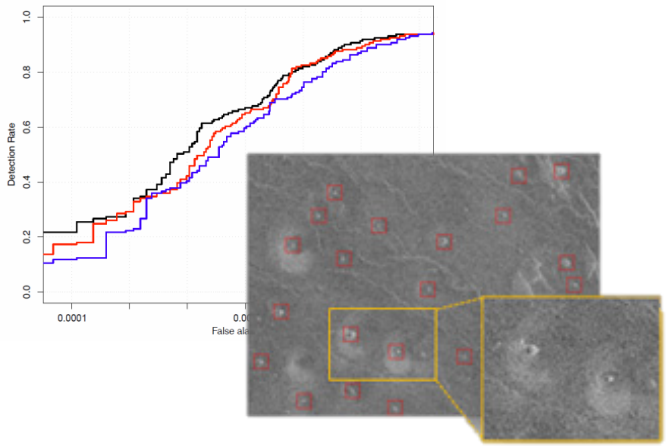
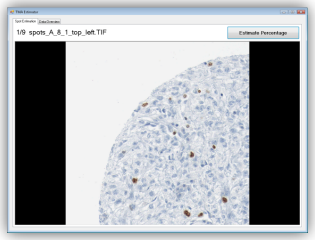




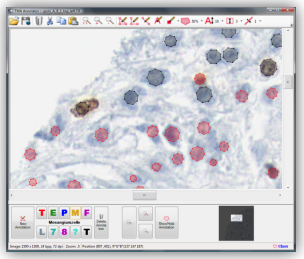
Volcanoes on Venus

TMA Estimator



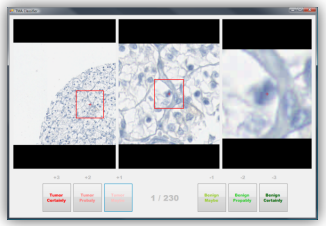
Estimate the Staining on a whole spot

TMA Annotator



Detect nuclei on a whole spot

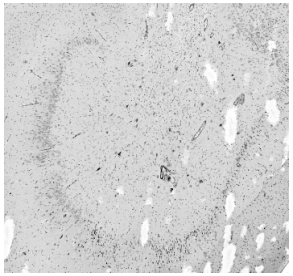
TMA Classifier



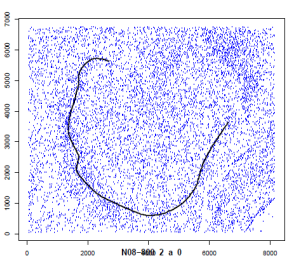
Classify single nuclei into tumor, non-tumor and stained, not-stained

Automated Classification

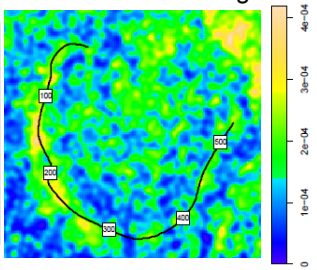
Original Image



Discriminative
Object Detection



Generative
P. Process Fitting



Feature/Object Detection

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Today

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- Good opportunities to look at collaborations around data-driven computational science approaches
  - Excellent speakers
- Recommend those that are interested to check out the Caltech/JPL Virtual Summer School on Big Data Analytics through Coursera or on the Caltech website
  - Started Sep 2, 2014
  - 1500 people signed up to watch
- I hope you enjoy the session!

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Backup

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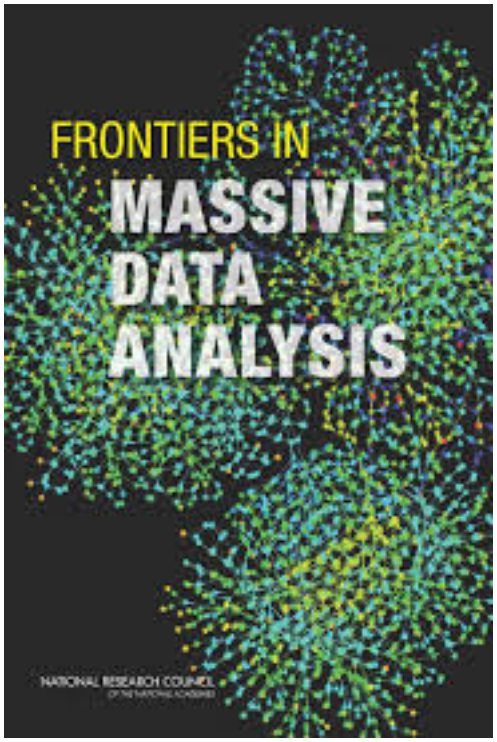
National Research Council: Frontiers in Massive Data Analsyis

- Chartered in 2010 by the National Research Council
- Chaired by Michael Jordan, Berkeley, AMP Lab (Algorithms, Machines, People)
- Importance of systematizing the analysis of data
- Need for end-to-end approaches to data analysis
- Integration of multiple disciplines
- Application of novel statistical and machine learning approaches for data discovery
- The movement from computation-intensive to data-intensive



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